MAR 1 6 1990

FLOOD INSURANCE STUDY

GRAYS HARBOR COUNTY, WASHINGTON
UNINCORPORATED AREAS

REVISED: FEBRUARY 16, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 530057

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original FIS. These revisions are presented in Section 9.0.

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Flood Boundary and Floodway Map

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Grays Harbor County, Washington, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This study was initiated by Tippetts-Abbett-McCarthy-Stratton (TAMS) for the Federal Emergency Management Agency (FEMA), under Contract No. H-4022. Some of the cross section data were collected under this initial contract.

The hydrologic and hydraulic analyses for this study were performed by CH2M HILL, Inc., for FEMA, under Contract Nos. H-4810 and EMW-C-0950. This study was completed in 1985.

1.3 Coordination

Representatives of FEMA, Grays Harbor County, and TAMS originally identified the streams requiring detailed and approximate study at a meeting held on April 8, 1976.

Representatives of CH2M HILL and Grays Harbor County met on April 16, 1981, to discuss flood problems.

Representatives of FEMA, Grays Harbor County, and CH2M HILL met on July 15, 1982. At this time, additional areas requiring detailed and approximate study were identified.

The U.S. Army Corps of Engineers (COE), the U.S. Geological Survey (USGS), and the U.S. Soil Conservation Service were contacted by the study contractors for additional information pertinent to this Flood Insurance Study.

The final community coordination meeting was held on September 25, 1985, and attended by representatives of FEMA, the study contractor, and the community. All significant problems raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of the Grays Harbor County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Areas not included in this study are the Quinault and Chehalis Indian Reservations, the Cities of Ocean Shores, Westport, Hoquiam, Aberdeen, Cosmopolis, Montesano, and Elma, and the Towns of McCleary and Oakville.

Flooding caused by the overflow of the following streams was studied in detail:

Chehalis River - River Mile (RM) 1.5 to 9.2, except the reach within the corporate limits of the City of Cosmopolis

Wynoochee River - RM 6.0 to 9.0

Satsop River - from confluence with Chehalis River to RM 8.0

Vance Creek - from U.S. Highway 12 to 0.5 mile north of Burlington Northern Railroad

Dry Bed Creek - from U.S. Highway 12 to 1,000 feet north of Burlington Northern Railroad

Harris Creek - from confluence with Chehalis River to 1,000 feet north of Burlington Northern Railroad

Roundtree Creek - from confluence with Harris Creek to 500 feet north of Burlington Northern Railroad

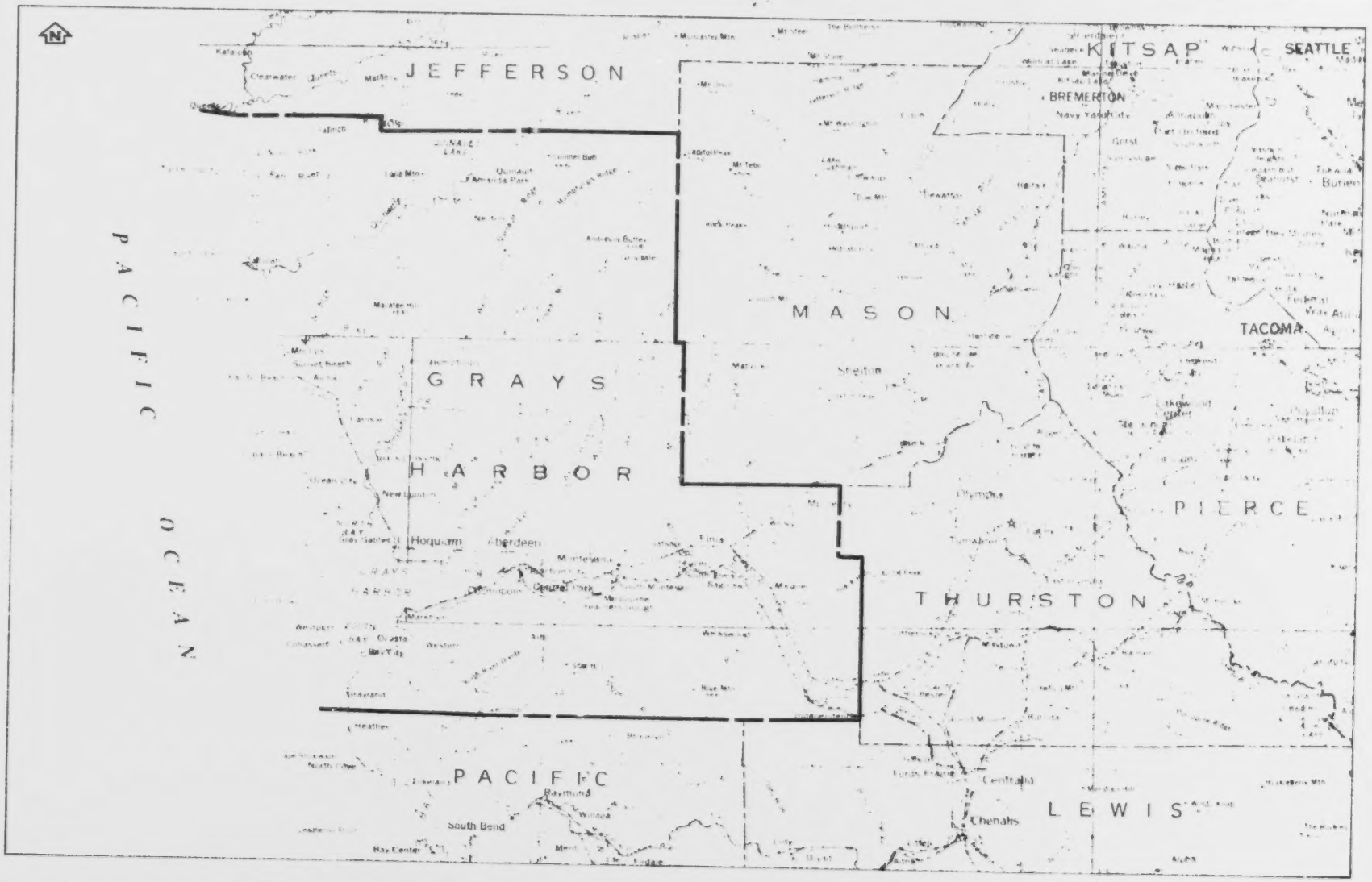

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

12 0 12 24 36 MILES

VICINITY MAP

Newman Creek - from confluence with Chehalis River to the fork of the East and West Branches of Newman Creek

Cloquallum Creek - from confluence with Chehalis River to the confluence with Bush Creek

Bush Creek - from confluence with Cloquallum Creek to the Cloquallum-Lost Lake Road

Pacific Ocean Coast - from the southern county boundary north to the Westport city limits

South Bay - from Hunt Club Road south of Laidlaw Island to the Westport city limits

Pacific Ocean Coast - from Ocean Shores city limits north to Copalis Rock National Wildlife Refuge

Pacific Ocean Coast - from Copalis Rock National Wildlife Refuge north to Copalis Head

Pacific Ocean Coast - from 0.3 mile south of State Highway 109 bridge over Joe Creek north for 0.6 mile, near Pacific Beach

Pacific Ocean Coast - from Quinault Indian Reservation south for 1.3 miles, near Moclips

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1990.

Approximate methods were used to study the indicated sections of the following streams:

Chehalis River - RM 9.2 to 44.9

Wynoochee River - from confluence with Chehalis River to RM 6.0

East Fork Wildcat Creek - reach within Sections 11 and 14, T18N, R5W, at McCleary, except that portion within the corporate limits of the Town of McCleary

West Branch Newman Creek - from the fork with East Branch Newman Creek to the north section line of Section 20, T18N, R6W

East Branch Newman Creek - from the fork with West Branch Newman Creek to the east section line of Section 16, T18N, R6W

Middle Branch Newman Creek - from the fork with West Branch Newman Creek to the east-west quarter section line of Section 16, T18N, R6W

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Grays Harbor County.

2.2 Community Description

Grays Harbor County is located in southwestern Washington. The Pacific Ocean forms the western boundary of the county, Pacific and Lewis Counties form the southern boundary, Thurston and Mason Counties form the eastern boundary, and Jefferson County forms the northern boundary. The Olympic Mountains rise in the northeast, and the Black Hills are in the southeast.

Grays Harbor is a large saltwater bay in the southern part of the county. Several major rivers discharge into Grays Harbor, including the Humptulips, Hoquiam, Wishkah, and Chehalis Rivers. The Chehalis River drains a large portion of the county. The Satsop and Wynoochee Rivers are the two major tributaries of the Chehalis River.

Development is restricted by topography, which is quite steep throughout the county. Therefore, most of the development has occurred along the coast and in the lower river valleys.

The major population center of the county is located in the Hoquiam-Aberdeen-Cosmopolis area, at the head of Grays Harbor. Remaining population areas are located along the coast or in the Chehalis River valley. The total population of the county in 1980 was 66,314. Of this total, 24,712 people lived in the unincorporated areas of the county.

The economy of the county is based principally on the forest industry. Other growing industries include fish processing, cranberry processing, and tourism.

Grays Harbor County has a mid-latitude, west coast, marine-type climate with warm and relatively dry summers, and mild, wet, mostly cloudy winters. Normal-annual precipitation varies from 50 inches in the southeast to over 240 inches in the high peaks of the Olympic Mountains. Most of the precipitation occurs between October and March. Vegetation varies from tidal flat and marshland grasses in the estuaries to forests of western hemlock, Douglas fir, and western red cedar.

2.3 Principal Flood Problems

Flooding in Grays Harbor County occurs principally in the winter. High spring tides and strong winds from winter storms produce storm surges that cause coastal flooding. Heavy rains with some snowmelt produce the highest runoff flows in the winter. The storms that produce the storm surges also bring heavy rains; therefore, the high riverflows are held back by tides, producing the greatest flooding at river mouths.

Flows have been recorded on the Chehalis River at Porter since January 1952. The two largest floods on record at this station had discharges of 55,660 cubic feet per second (cfs) (January 1972) and 49,600 cfs (January 1971). The COE estimates the recurrence intervals for these floods are once in 75 years and once in 60 years, respectively (Reference 1).

The COE completed construction of a dam on the Wynoochee River at RM 51.8 in August 1972. Until January 1982, the highest flow recorded at the gage located just above Black Creek was 18,100 cfs in December 1972. Based on the exceedence-frequency curve developed by the USGS for this gaging site, this discharge has a recurrence interval of approximately once in 2 years.

There is a gage on the Satsop River at RM 2.3. This gage has been in operation since March 1929. The highest discharge recorded at the gage has been 46,600 cfs in January 1935. Based on the exceedence-frequency curve developed by the USGS for this gaging site, this discharge has a recurrence interval of approximately once in 50 years.

The gage on Cloquallum Creek was located just downstream of the State Highway 12 bridge. This gage was operated continuously from July 1944 to September 1972. Annual peak discharges were recorded for 1973 through 1979. From 1944 to 1979, the highest discharge recorded at this gage was 5,080 cfs. This discharge was recorded on December 15, 1959. Based on the exceedence-frequency curve developed by the USGS for this gaging site, this discharge has a recurrence interval of approximately once in 20 years.

2.4 Flood Protection Measures

Levees are located along the reach of the Chehalis River between Montesano and Satsop. There are also levees along both sides of the Copalis River in the vicinity of the Town of Copalis. However, all of these levees are too low to contain the 100-year flood.

The Wynoochee Dam was completed in August 1972 and has resulted in reduced flooding downstream.

No effective physical protection from a 100-year storm exists on other streams or coastal reaches in the study area.

Grays Harbor County passed Ordinance Number 97 in August 1981. The subject of this ordinance is flood plain management.

Parts of the Chehalis, Satsop, and Wynoochee Rivers are in Flood Control Zone 13. Therefore, these areas are subject to State rules on flood plain development. These rules are enforced by the Washington State Department of Ecology.

The National Weather Service issues flood warnings as necessary for the Chehalis River basin.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The 100-year discharge at the mouth of the Chehalis River was obtained from a 1975 report on the Chehalis River prepared by the COE (Reference 2). The 100-year discharge of the Chehalis River at Porter was obtained from the exceedence-frequency relationship developed by the USGS for the gage date at that location.

The Satsop River exceedence-frequency relationships were obtained from the USGS analysis of 50 years of data collected for the gage located at RM 2.3.

The Wynoochee River exceedence-frequency relationships were obtained from the USGS analysis of 24 years of data collected for the gage located just above Black Creek. The USGS analysis included the effects of the Wynoochee Dam.

The Cloquallum Creek exceedence-frequency relationships were obtained from the USGS analysis of 35 years of data collected for the gage near the State Highway 12 bridge.

The other streams studied are ungaged. The 10-, 50-, 100-, and 500-year flows for each of these streams were determined by the application of the methodology described in Magnitude and Frequency of Floods in Washington (Reference 3). Peak discharge-drainage area relationships for all the streams studies in detail are shown in Table 1.

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Flood damage in tidal and coastal areas results from high astronomical tide levels, storm surge, and wave setup and runup. These water-level fluctuations can occur simultaneously. Surface wave setup, high astronomical tides, and storm surge can occur coincidently at the shore on the open coast. Astronomical tides fluctuate because of gravitational effects of the moon and sun. Storm surges are caused by low atmospheric pressure and by the wind stress accompanying moving storm systems. Wave setup, the wave-induced buildup of water levels shoreward, adds to flood levels. Wave energy produces wave runup after breaking occurs. The velocity and height associated with wave runup cause damage above the stillwater level. The stillwater level reflects flood levels due to all sources except wave runup.

Estimated tidal levels for the selected recurrence intervals were determined by adding the stillwater levels to computed wave runup for wave and breaker heights associated with the same storm frequency.

Stillwater levels for the Pacific Ocean coast were based on the levels determined for the Pacific Ocean coast in the Flood Insurance Study for the City of Ocean Shores (Reference 4).

Stillwater levels for South Bay were based on the levels determined for South Bay in the Flood Insurance Study for the City of Westport (Reference 5).

Stillwater levels for Grays Harbor were based on the tidal frequency analysis performed by the COE for the data recorded from 1912 to 1964 at the Port of Grays Harbor staff gage (Reference 2).

Elevations for floods of the selected recurrence intervals on the Pacific Ocean, Grays Harbor, and South Bay are shown in Table 2.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Chehalis River					
At Mouth at Grays Harbor	2,114	55,000	70,500	77,000	102,000
Satsop River					
River Mile 2.3 Gage	299	36,200	47,500	52,300	62,500
East Fork Satsop River					
Confluence With West Fork Satsop River	199	25,500	33,500	36,900	44,000
Wynoochee River					
Above Black Creek	155	18,000	20,500	23,000	28,500
Above Wedekind Creek	141	16,600	18,900	21,200	26,300
Newman Creek					
Confluence With Vance Creek	13.5	890	1,270	1,450	1,880
Above Montesano-Elma Road	8.9	630	890	1,010	1,310
Harris Creek					
Above Garrard Creek Road	3.7	200	278	314	345
Confluence With Roundtree Creek	1.3	83	114	129	164
Roundtree Creek					
Confluence With Harris Creek	1.4	86	119	134	170
Cloquallum Creek					
Confluence With Chehalis River	66.4	4,680	5,920	6,420	7,540
Above State Highway 12	64.9	4,590	5,800	6,290	7,390
Above Wildcat Creek	39.6	3,020	3,790	4,110	4,830
Bush Creek					
Confluence With Cloquallum Creek	4.2	388	550	624	795

Table 2. Summary of Stillwater Elevations

Flooding Source and Location	Wave Runup Elevation (Feet)				Wave Setup Elevation (Feet)			
	10-Year	50-Year	100-Year	500-Year	10-Year	50-Year	100-Year	500-Year
Pacific Ocean								
At Moclips	14.9	19.5	21.9	25.8				
South of Moclips	15.6	21.0	24.4	28.4				
At Pacific Beach	15.8	21.3	24.8	28.9				
At Beaver Creek	14.2	18.1	19.5	23.5				
0.8 Mile South of Boone Creek	17.3	24.6	30.3	34.7				
1.0 Mile South of Boone Creek	15.7	21.2	24.7	28.7				
North of Copalis Rock National Wildlife Refuge	14.5	18.6	20.4	24.1				
From Copalis Rock National Wildlife Refuge to City of Ocean Shores	14.7	19.0	21.0	24.8				
At Westport	15.1	19.8	22.3	26.2				
South of Westport	15.8	21.4	25.0	29.1				
North of Grayland	16.1	22.1	26.1	30.2				
At Grayland	15.5	20.7	23.9	27.8				
From Moclips to Grayland					7.6	9.2	9.8	11.7
Grays Harbor								
Port of Grays Harbor					8.8	9.7	10.0	10.5
South Bay					8.7	9.9	10.4	12.6

The COE Waterways Experiment Station, Vicksburg, Mississippi, has completed a study of flood levels on the west coast due to tsunamis (waves of seismic origin). The results of the study show that tsunami-caused flooding at the 100-year level is lower than that caused by winter storms (Reference 6).

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

The hydraulic analysis of the Chehalis River is based on the COE report, Suggested Hydraulic Floodway Chehalis River, Aberdeen to Satsop and Vicinity, Grays Harbor County, Washington (Reference 7). That report indicates that the tidal influence of Grays Harbor extends up the Chehalis River to Satsop. The study determined only the 100-year flood elevations. The 50- and 500-year flood elevations for the Chehalis River were not determined, and therefore have not been included in this study. The 10-year flood elevation for the Chehalis River was assumed to be the higher of the river-bank elevation or the 10-year tidal elevation.

For Satsop River, Wynoochee River, Newman Creek, Cloquallum Creek, Bush Creek, Harris Creek, and Roundtree Creek, the water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 8). Cross sections for the backwater analyses of Satsop River, Wynoochee River, Harris Creek, and Roundtree Creek were field surveyed by TAMS (Reference 9) under the original study contract and were visually checked by CH2M HILL. Additional cross sections for these streams were field surveyed by CH2M HILL, to better approximate the shape of the flood channels. CH2M HILL also field surveyed the cross sections for Newman Creek, Cloquallum Creek, Bush Creek, and Copalis River.

Vance and Dry Bed Creeks flow through a flat plain. Flooding from these creeks is considered shallow, and the HEC-2 backwater analysis is not appropriate. Depths were determined from normal-depth calculations and were found to be less than 1 foot.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

The HEC-2 model for the Satsop River above the USGS gaging stations was calibrated by adjusting the Manning's "n" values so that the elevations of observed high-water marks were reproduced to a reasonable degree by the computer model. This process resulted in unusually

high "n" values. These varied from 0.18 to 0.3 for overbank areas and had a value of 0.15 for the channel.

The reach of the Satsop River from its mouth to the USGS gaging station (RM 2.3) was calibrated by matching the elevations at the gaging station predicted by the HEC-2 computer analysis with the elevations for those discharges from the USGS stage-discharge curve for the gage. In this case, the Mannings "n" for the channel was 0.035 and for the overbank areas was 0.07.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations for the other streams studied in detail were chosen by engineering judgment and based on field observations of the stream and flood plain areas. Manning's "n" values for these streams varied from 0.03 to 0.06 in channel sections and from 0.05 to 0.12 in overbank areas.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals (Exhibit 1). Starting water-surface elevations for Newman Creek, Cloquallum Creek, Harris Creek, and the Satsop River were determined by the slope-area method. Starting water-surface elevations for the Wynoochee River were specified from the stage-discharge relationships derived by the USGS at the gaging station on this river.

The elevation of the 10-year tide was used for the starting water-surface elevation for the Copalis River for the 100-year riverine flood. The results of this analysis indicated that the 100-year stillwater elevation for the Pacific Ocean is higher than the water-surface elevation anywhere in the study reach because of the 100-year discharge on the Copalis River. Therefore, for the section of the Copalis River that was studied in detail, base flood elevations were determined from the stillwater tidal elevations for the Pacific Ocean in this area.

The determinations of wave runup for the stretches of the Pacific Ocean coast studied in detail were based on previous determinations for similar beaches for the Ocean Shores Flood Insurance Study (Reference 4) and for the Pacific County Flood Insurance Study (Reference 10).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using various topographic maps. The maps used for Harris Creek, Roundtree Creek, and the Chehalis River above Porter had a scale of 1:2,400, and a contour interval of 5 feet (Reference 11). The topographic maps used for the analysis of the Pacific Ocean coast near Grayland were produced for this study and were at a scale of 1:3,600, with a contour interval of 2 feet (Reference 12). The topographic maps used for the analyses of the Copalis River, South Bay, and the stretches of the Pacific Ocean coast along Copalis Beach, south of Copalis Head, near Pacific Beach, near Moclips, and between Grayland and Westport were produced for this study and were at a scale of 1:4,800, with a contour interval of 2 feet (Reference 13). The topographic maps used for the rest of the areas studied were USGS topographic maps at a scale of 1:62,500, with contour intervals of 40 and 80 feet (Reference 14).

Flood boundaries for Vance and Dry Bed Creeks were determined by combining engineering judgment with discussions with the residents of the affected areas about past floods.

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The 100-year flood plain boundaries were taken from the 1976 and 1978 COE studies (Reference 15 and 7, respectively) for the section of the Chehalis River below Porter that was specified as an approximate-study area.

For the other streams studies by approximate methods, the boundary of the 100-year flood was developed from normal-depth calculations and the topographic maps referenced.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

Approximate 100-year flood plain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map (Reference 16).

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

With approval of the FEMA Consultation Coordination Officer, no floodway was determined for the areas that are subject to tidal flooding. These areas include the portions of the Chehalis and Copalis Rivers that were studied by detailed methods.

The floodways for Satsop River, Wynoochee River, Newman Creek, Harris Creek, Roundtree Creek, Cloquallum Creek, and Bush Creek were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Wynoochee River								
A	31,500	1,925	9,824	2.3	40.9	40.9	41.9	1.0
B	34,580	1,144	5,517	4.2	43.4	43.4	44.4	1.0
C	37,180	1,196	9,206	2.5	45.9	45.9	46.9	1.0
D	40,580	1,481	9,830	2.3	48.2	48.2	49.2	1.0
E	41,940	594	4,505	5.1	50.4	50.4	51.4	1.0
F	43,420	908	7,180	3.2	53.3	53.3	54.3	1.0
G	45,820	1,959	9,642	2.2	55.3	55.3	56.3	1.0
H	48,220	850	5,537	3.8	56.8	56.8	57.8	1.0
Satsop River								
A[2]	9,180				32.2	32.2		
B[2]	10,450				36.5	36.5		
C[2]	11,100				37.1	37.1		
D	12,100	3,362	22,103	2.4	39.6	39.6	40.6	1.0
E	13,600	3,336	32,497	1.6	43.9	43.9	44.9	1.0
F	17,480	3,294	37,090	1.4	48.3	48.3	49.3	1.0
G	19,720	2,774	27,021	1.9	51.5	51.5	52.5	1.0
H	23,360	4,274	44,029	1.2	55.0	55.0	56.0	1.0
I	27,240	3,738	40,998	1.3	57.4	57.4	58.4	1.0
J	31,400	1,478	18,877	2.8	64.9	64.9	65.9	1.0
K	34,640	1,953	24,951	1.5	69.8	69.8	70.8	1.0
L	37,640	2,284	24,868	1.5	72.8	72.8	73.8	1.0
M	41,340	2,085	19,410	1.9	78.4	78.4	79.4	1.0

[1]Feet Above Mouth [2]Floodway Not Computed for This Cross Section

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

WYNOOCHEE RIVER-SATSOP RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Newman Creek								
A	15,320	25	181	5.6	44.0	44.0	44.4	0.4
B	15,488	38	266	3.8	44.6	44.6	45.1	0.5
C	15,578	29	244	4.1	44.8	44.8	45.3	0.5
D	17,360	27	177	5.7	48.4	48.4	49.1	0.7
E	17,555	50	274	3.7	48.9	48.9	49.9	1.0
F	17,830	53	299	3.4	49.6	49.6	50.3	0.7
G	18,080	44	147	6.9	51.4	51.4	51.7	0.3
H	18,280	306	367	2.8	53.0	53.0	53.2	0.2
I	19,570	75	234	4.3	56.1	56.1	57.1	1.0
J	20,700	974	1,004	1.0	58.2	58.2	59.2	1.0
K	20,794	738	308	3.3	58.2	58.2	59.2	1.0
L	20,894	72	113	9.0	59.6	59.6	59.8	0.2
M	22,800	102	375	2.7	66.6	66.6	67.6	1.0
N	24,300	176	194	5.2	70.4	70.4	70.7	0.3
O	24,424	30	146	6.9	70.8	70.8	71.6	0.8
P	24,544	61	193	5.2	72.4	72.4	72.5	0.1
Q	25,930	199	497	2.0	74.9	74.9	75.9	1.0
R	26,147	100	155	6.5	75.9	75.9	76.6	0.7
S	26,500	97	413	2.4	77.2	77.2	78.2	1.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

NEWMAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Harris Creek								
A	7,133	46	90	3.5	74.0	74.0	75.0	1.0
B	7,160	280	1,833	0.2	74.3	74.3	75.2	0.9
C	8,110	208	768	0.4	74.4	74.4	75.3	0.9
D	9.060	41	82	3.8	74.5	74.5	75.3	0.8
E	10,030	63	184	1.7	78.1	78.1	79.1	1.0
F	10,152	22	71	4.4	78.5	78.5	78.5	0.0
G	10,200	38	110	2.8	78.9	78.9	78.9	0.0
H	10,720	18	75	4.2	79.6	79.6	80.6	1.0
I	11,660	223	411	0.8	81.2	81.2	82.2	1.0
J	11,790	10	51	2.5	81.8	81.8	82.7	0.9
K	11,860	11	30	4.4	82.1	82.1	82.1	0.0
L	12,060	165	205	0.6	82.5	82.5	82.8	0.3
M	12,740	13	19	6.9	91.1	91.1	91.1	0.0
Roundtree Creek								
A	620	18	59	2.3	81.3	81.3	82.3	1.0
B	1,150	26	82	1.6	82.3	82.3	83.1	0.8
C	1,610	26	45	3.0	83.6	83.6	83.8	0.2
D	1,689	5	14	9.8	84.5	84.5	84.5	0.0
E	1,740	29	98	1.4	86.5	86.5	86.6	0.1
F	1,860	54	137	1.0	86.5	86.5	86.7	0.2
G	2,140	13	28	4.8	86.8	86.8	87.1	0.3
H	2,216	6	21	6.5	88.8	88.8	88.8	0.0
I	2,327	7	46	2.9	91.0	91.0	91.0	0.0
J	2,950	13	19	6.9	105.9	105.9	105.9	0.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

HARRIS CREEK-ROUNDTREE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (METERS)	SECTION AREA (SQUARE METERS)	MEAN VELOCITY (METERS PER SECOND)	REGULATORY	WITHOUT FLOODWAY (METERS MSL)	WITH FLOODWAY (METERS MSL)	INCREASE
Cloquallum Creek								
A	6,900	150	1,274	5.0	42.0	42.0	42.8	0.8
B	7,122	126	1,111	5.8	42.3	42.3	43.2	0.9
C	9,522	176	1,153	5.6	46.6	46.6	47.2	0.6
D	11,522	125[2]	939	6.8	50.5	50.5	51.5	1.0
E	11,761	100[2]	847	7.4	51.5	51.5	52.5	1.0
F	14,561	380/180[3]	1,844	3.4	57.5	57.5	58.4	0.9
G	18,361	160	1,032	6.1	64.1	64.1	64.9	0.8
H	18,531	220	1,937	3.2	66.4	66.4	66.7	0.3
I	19,131	509	3,115	2.0	66.6	66.6	67.3	0.7
J	19,495	595	4,646	1.4	69.0	69.0	69.3	0.3
K	22,695	149	573	11.0	73.1	73.1	73.6	0.5
L	23,445	866	2,404	1.7	76.7	76.7	77.7	1.0
M	23,700	106	796	5.2	80.6	80.6	80.6	0.0
N	24,000	163	1,152	3.6	80.6	80.6	81.1	0.5
O	24,186	145	1,310	3.1	84.0	84.0	84.0	0.0
P	26,186	149	425	9.7	86.5	86.5	86.5	0.0
Bush Creek								
A	70	28	134	4.7	89.1	89.1	89.3	0.2
B	2,070	18	59	10.5	101.5	101.5	101.5	0.0

[1]Feet Above Mouth [2]Floodway Lies Entirely Outside County Limits [3]Width/Width Within County Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

CLOQUALLUM CREEK-BUSH CREEK

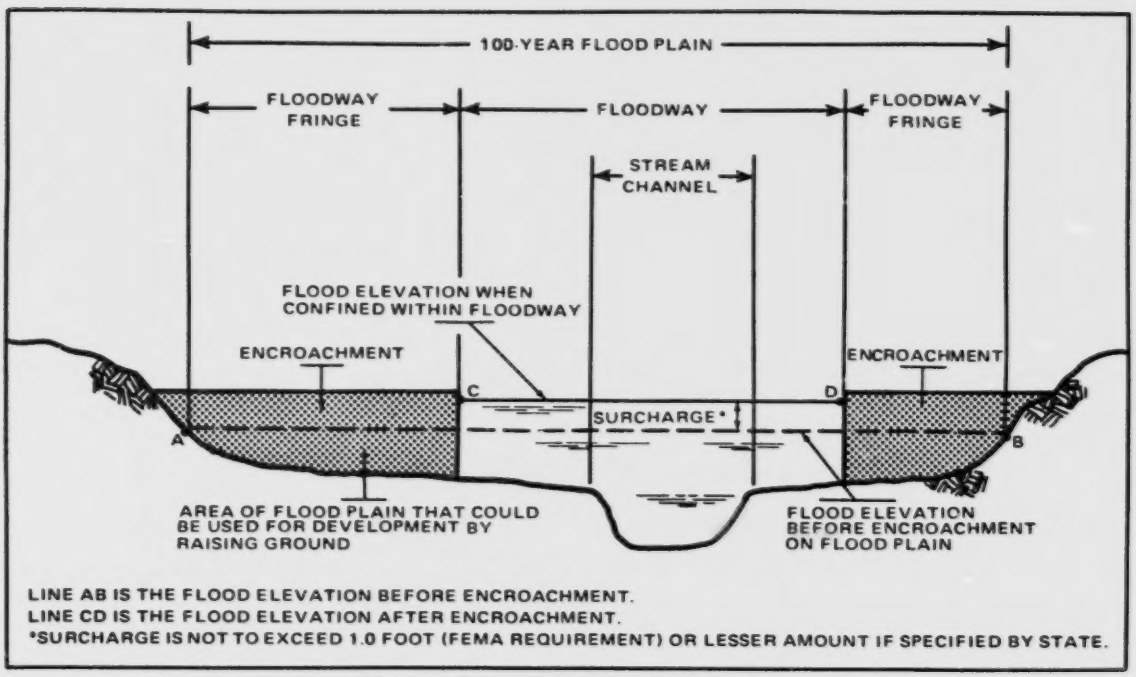
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Grays Harbor County, Washington.

5.1 Reach Determinations

Riverine reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Wynoochee River Reach 1	0338	-1.0	-0.5	0.9	010	A2	Varies - See Map
Satsop River Reach 1	0342,0344, 0432	-2.0	-0.5	1.1	020	A4	Varies - See Map
Newman Creek Reach 1	0344,0361, 0363,0432	-1.1	-0.3	0.5	010	A2	Varies - See Map
Shallow Flooding	0344	N/A	N/A	N/A	N/A	A0	Depth 1
Grays Harbor (Backwater on Chehalis River) Reach 1	0407,0409	-1.2	-0.3	0.5	010	A2	10
Chehalis River Reach 1	0407,0409 0426,0428	-1.6	--[4]	--[4]	015	A3	Varies - See Map
Harris Creek Reach 1	0582	-0.7	-0.2	0.3	005	A1	Varies - See Map
Roundtree Creek Reach 1	0582	-0.5	-0.2	0.2	005	A1	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot [4]Not Determined

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

WYNOOCHEE RIVER-SATSOP RIVER-NEWMAN CREEK-GRAYS HARBOR (BACKWATER ON CHEHALIS RIVER)-CHEHALIS RIVER-HARRIS CREEK-ROUNDTREE CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Cloquallum Creek							
Reach 1	0365,0455	-0.9	-0.2	0.5	010	A2	Varies - See Map
Bush Creek							
Reach 1	0365	-0.6	-0.1	0.3	005	A1	Varies - See Map
Pacific Ocean							
Moclips							
Reach 1	0205	-7.0	-2.4	3.9	070	V14	22
Reach 2	0205	-8.8	-3.4	4.0	090	V18	24
Reach 3	0205	-2.2	--[4]	--[4]	020	V4	10
Pacific Beach							
Reach 4	0215	-9.0	-3.5	4.1	090	V18	25
Reach 5	0215	-5.3	-1.4	4.0	055	V11	20
Copalis Head							
Reach 6	0215	-13.0	-5.7	4.4	130	V26	30
Reach 7	0215	-9.0	-3.5	4.0	090	V18	25
Reach 8	0215,0280	-5.9	-1.8	3.7	060	V12	20
Copalis Beach							
Reach 9	0280	-2.2	-0.6	1.9	020	A4	10
Reach 10	0280,0290	-6.3	-2.0	3.8	065	V13	21
Reach 11	0280,0290	-2.2	-0.6	1.9	020	A4	10

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot [4]Data Not Available

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

CLOQUALLUM CREEK-BUSH CREEK-PACIFIC OCEAN

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Pacific Ocean (cont'd)							
West Port							
Reach 12	0390,0395 0510	-7.2	-2.5	3.9	070	V14	22
Reach 13	0510	-9.2	-3.6	4.1	090	V18	25
Greyland							
Reach 14	0510	-10.0	-4.0	4.1	100	V20	26
Reach 15	0510	-8.4	-3.2	3.9	085	V17	24
South Bay							
Reach 1	0395,0510	-1.7	-0.5	2.2	015	A3	10

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

PACIFIC OCEAN

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Grays Harbor County, Washington, are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

In tidal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, 16 reaches were required for the flooding sources of the unincorporated areas of Grays Harbor County. The locations of these reaches are shown on the Flood Insurance Rate Map.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zone AO: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.

Zones A1, A2, A3, and A4:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zones V11, V12, V13, V14, V17, V18 V20, and V26:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the unincorporated areas of Grays Harbor County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

An Interim Floodplain Management Plan (Reference 1) was produced by the Grays Harbor Regional Planning Commission in 1973. Maps in that report showed the approximate boundary of the 100-year flood for the Chehalis River. Variations betweeen the results of that study and this study are due to the detailed nature of this study.

The Chehalis River analysis was based on the 1976 and 1978 COE studies (Reference 15 and 7, respectively).

Flood Insurance Studies for the Cities of Cosmopolis, Aberdeen, Hoquiam, Westport, and Ocean Shores, and the Towns of McCleary and Oakville have been published (References 17, 18, 19, 5, 4, 20, and 21, respectively). The Flood Insurance Study for the unincorporated areas of Pacific County (Reference 10) is being extended to include areas not previously studied. The results of the present study for the unincorporated areas of Grays Harbor County and these other Flood Insurance Studies are compatible, except along some stretches of the Pacific Ocean coast.

There have been changes in the method of determining zone designations for velocity hazard areas along the Pacific Ocean coast. Originally, the velocity zone extended until the ground elevation was 4 feet below the 100-year flood elevation (e.g., stillwater and wave runup). Subsequently, the velocity zone was extended to the lower of the top of the primary dunes or the 100-year flood elevation. The method used for zone designation in the Ocean Shores and the Pacific County Flood Insurance Studies (Reference 4 and 10, respectively) was the former. This latter method was used for the Westport Flood Insurance Study (Reference 5) and for this study of the unincorporated areas of Grays Harbor County.

The other published flood information for the unincorporated areas of Grays Harbor County is the Flood Hazard Boundary Map (Reference 16). Where an area is covered by the Flood Insurance Rate Map, this Flood Insurance Study supersedes the previously published map, because this study uses a more detailed analysis. Elsewhere, the Flood Hazard Boundary Map is authoritative.

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98011.

8.0 BIBLIOGRAPHY AND REFERENCES

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4. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Ocean Shores, Grays Harbor County, Washington, 1978

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15. U.S. Department of the Army, Corps of Engineers, Seattle District, Chehalis River Basin, Washington, Chehalis River - Satsop to Porter, Water-Surface Profiles, April 1976

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17. Federal Emergency Management Agency, Flood Insurance Study, City of Cosmopolis, Grays Harbor County, Washington, 1982

18. Federal Emergency Management Agency, Flood Insurance Study, City of Aberdeen, Grays Harbor County, Washington, 1984

19. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Hoquiam, Grays Harbor County, Washington, December 1979

20. Federal Emergency Management Agency, Flood Insurance Study, Town of McCleary, Grays Harbor County, Washington, 1982

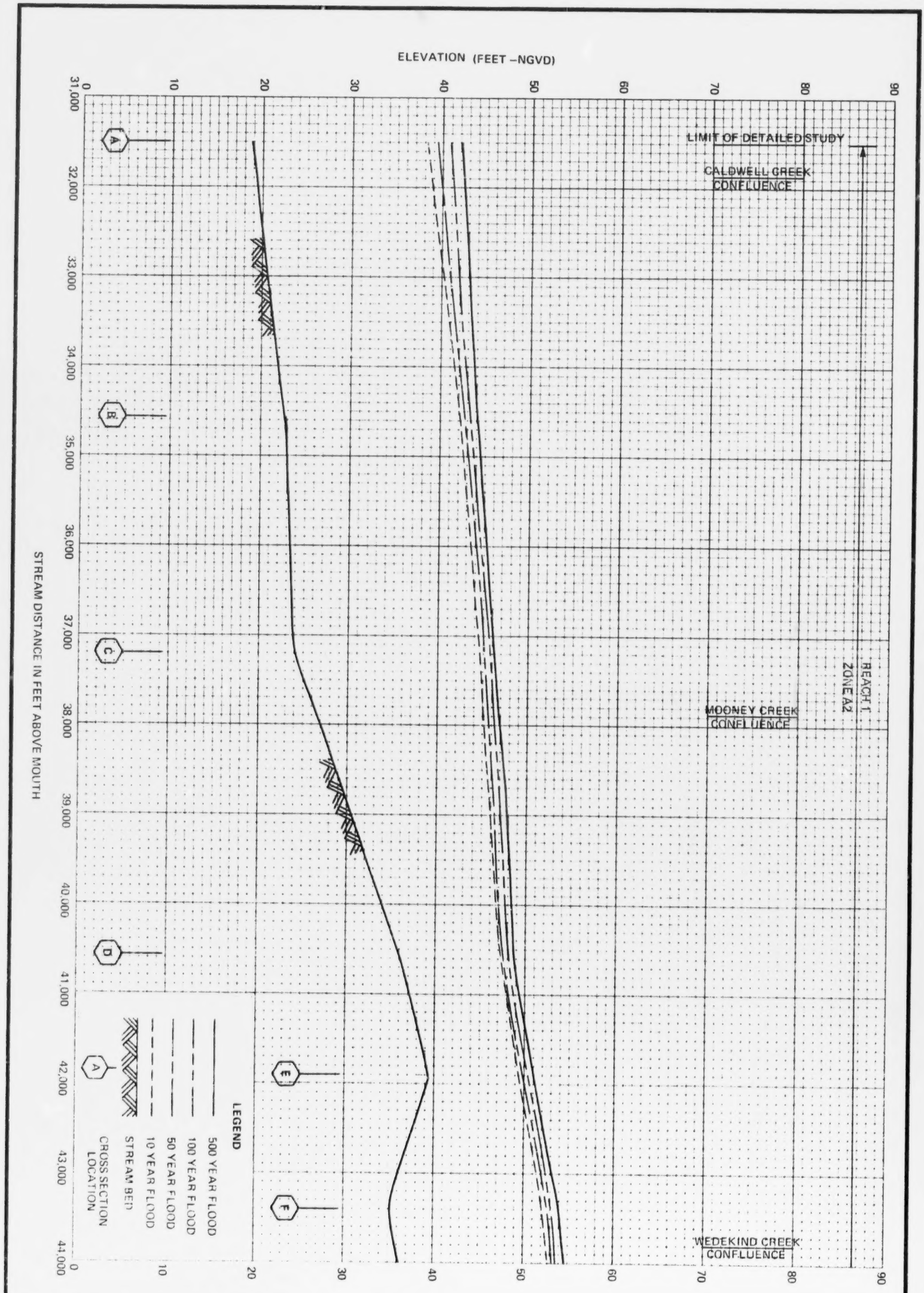
21. Federal Emergency Management Agency, Flood Insurance Study, Town of Oakville, Grays Harbor County, Washington, 1985

9.0 REVISIONS DESCRIPTION

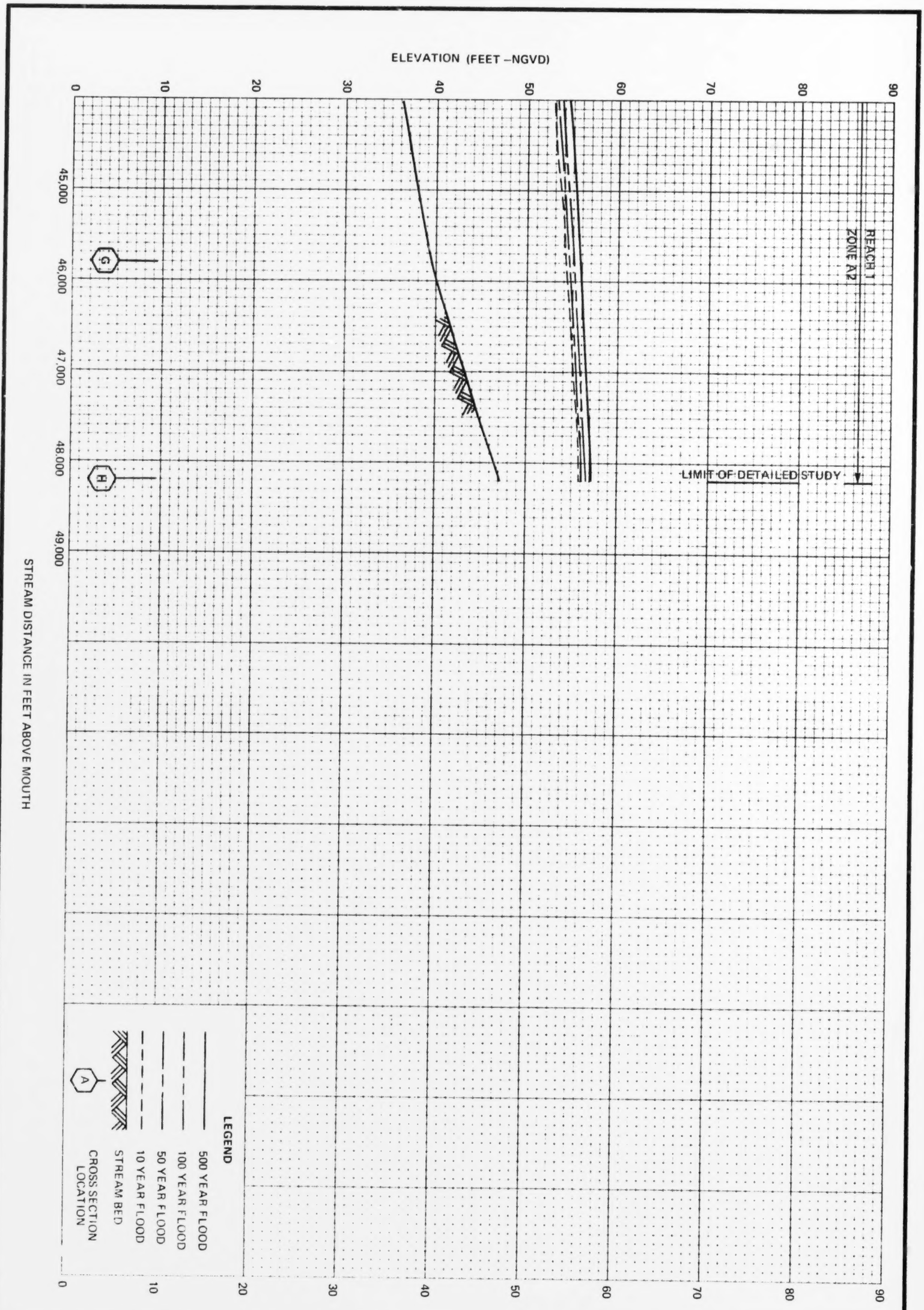
This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at the Grays Harbor County Court House, Montaseno, Washington.

9.1 First Revision

This study was revised on February 16, 1990, to incorporate the effects of revised wave run-up and wave height analyses for a reach of the Pacific Ocean, north of the mouth of Connor Creek, in the area of Copalis Beach. The revised analyses were based on improved topographic information for the referenced reach, which was prepared by the developers of Sea View Estates, and submitted by the Planning Director of Grays Harbor County. The result of the new analyses was a modification of the floodplain boundary delineations and zone designations along the referenced reach as shown on FIRM Panel 0280. The revised delineations decreased the Zone V13 (EL 21) to Zone V13 (EL 18) and Zone V13 (EL 15), changed the zone designation in the area of Sea View Estates from Zone V13 (EL 21) to Zone AO (Depth 2), and from Zone B to Zone AO (Depth 2). The Coastal Data Table - 4 was not revised.



01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **GRAYS HARBOR COUNTY, WA** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **WYNOOCHEE RIVER**



FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

WYNOOCHEE RIVER

02P

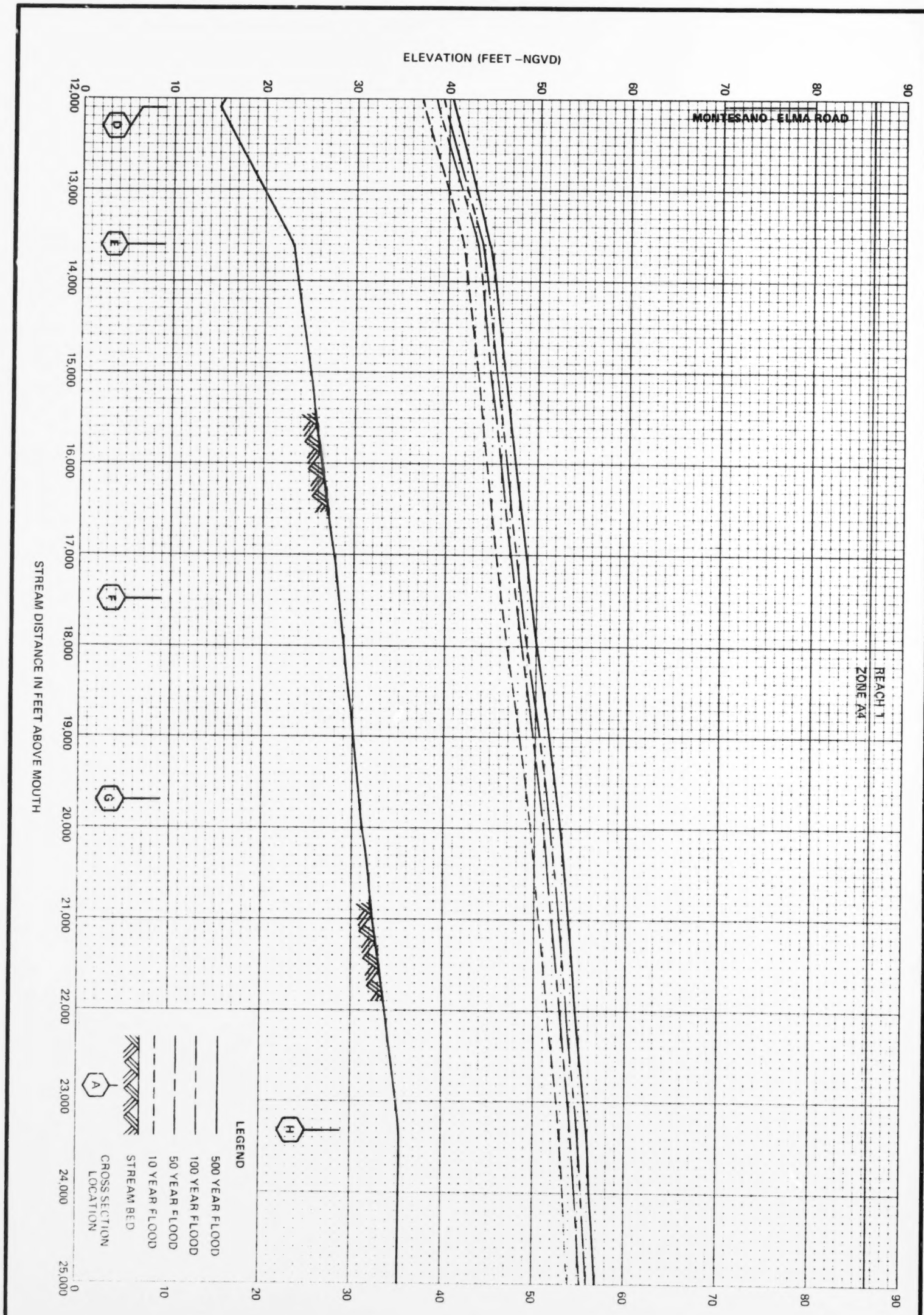
FLOOD PROFILES

SATSOP RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

03P



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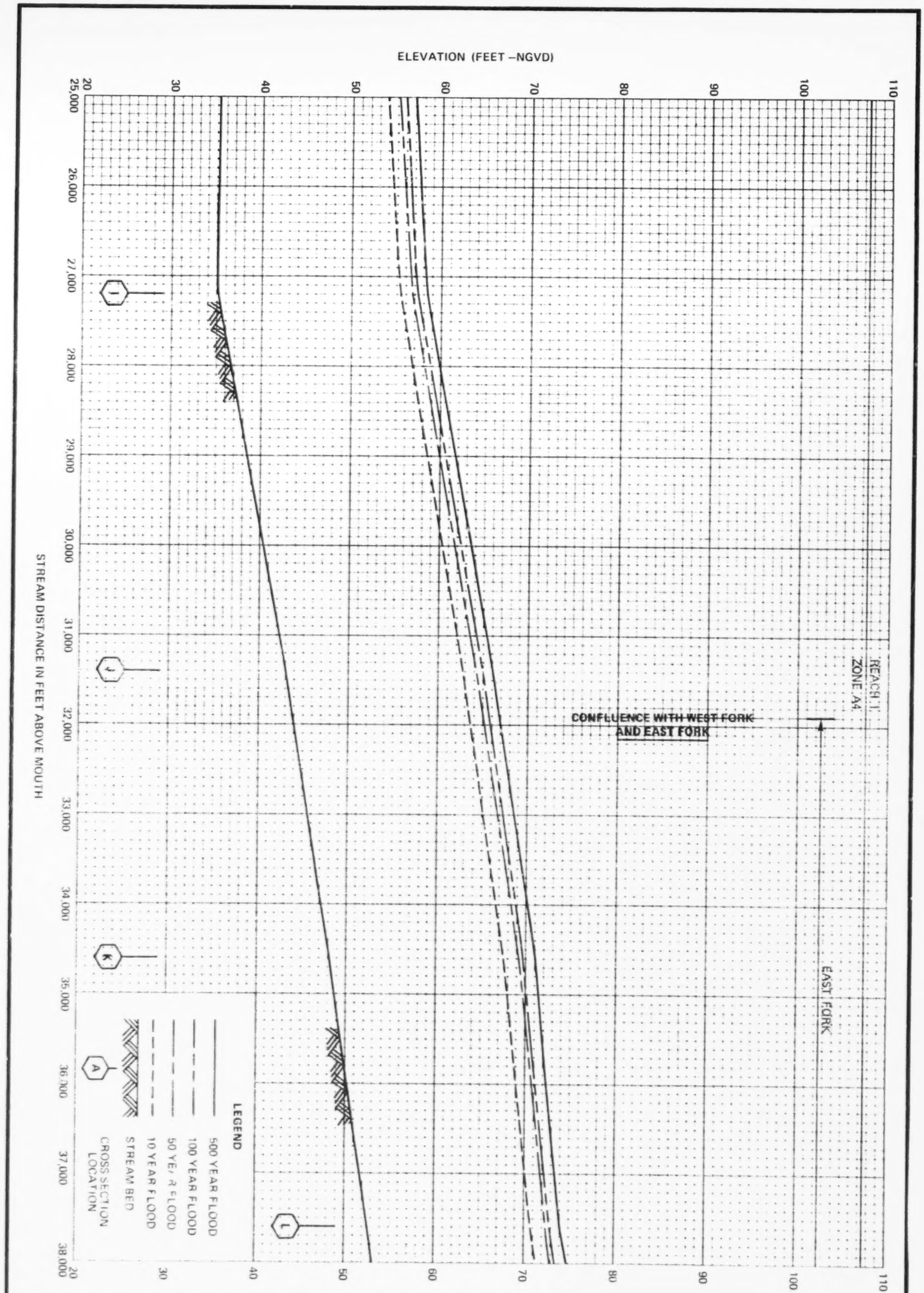
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

04P

FLOOD PROFILES

SATSOP RIVER



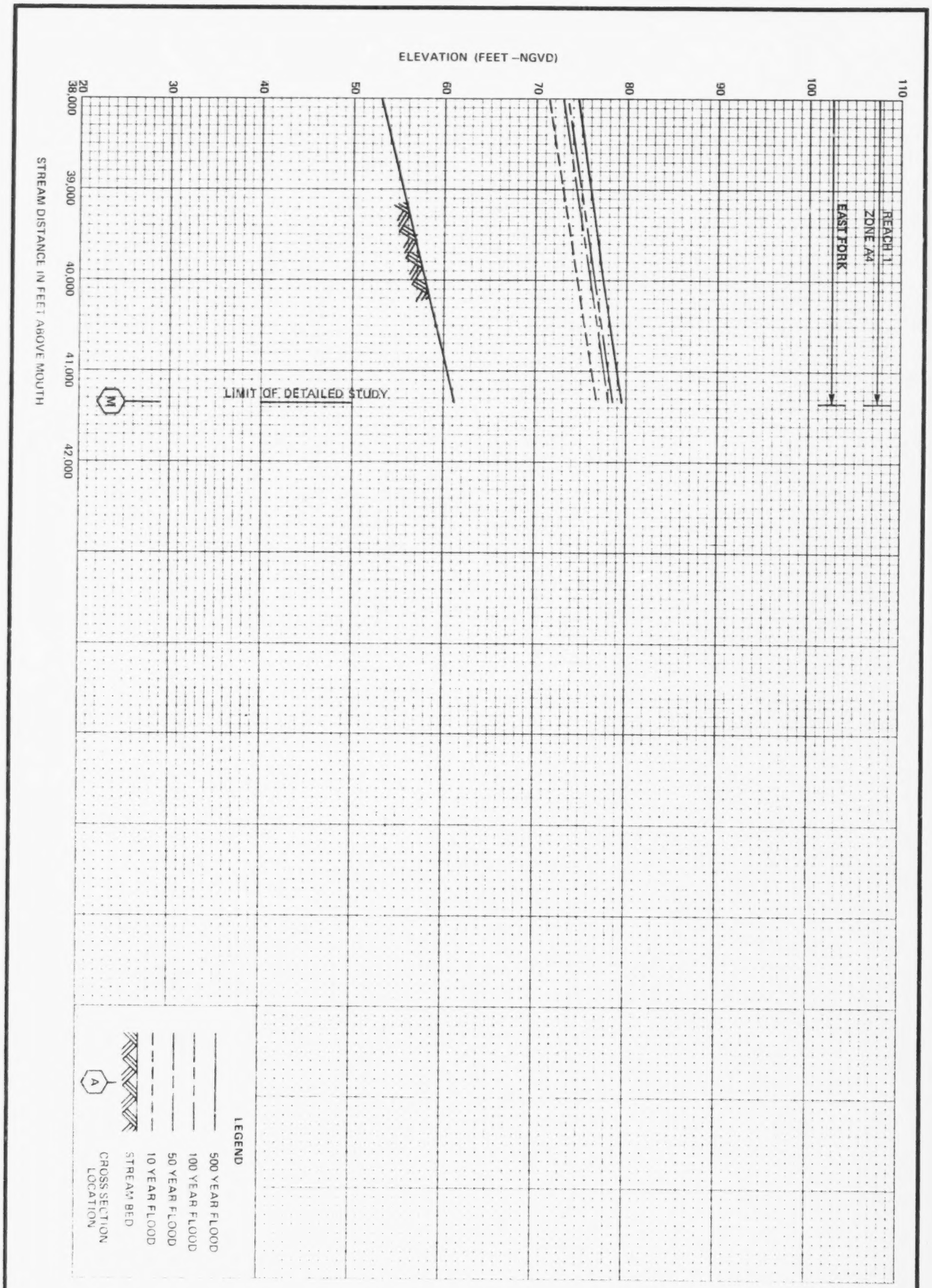
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

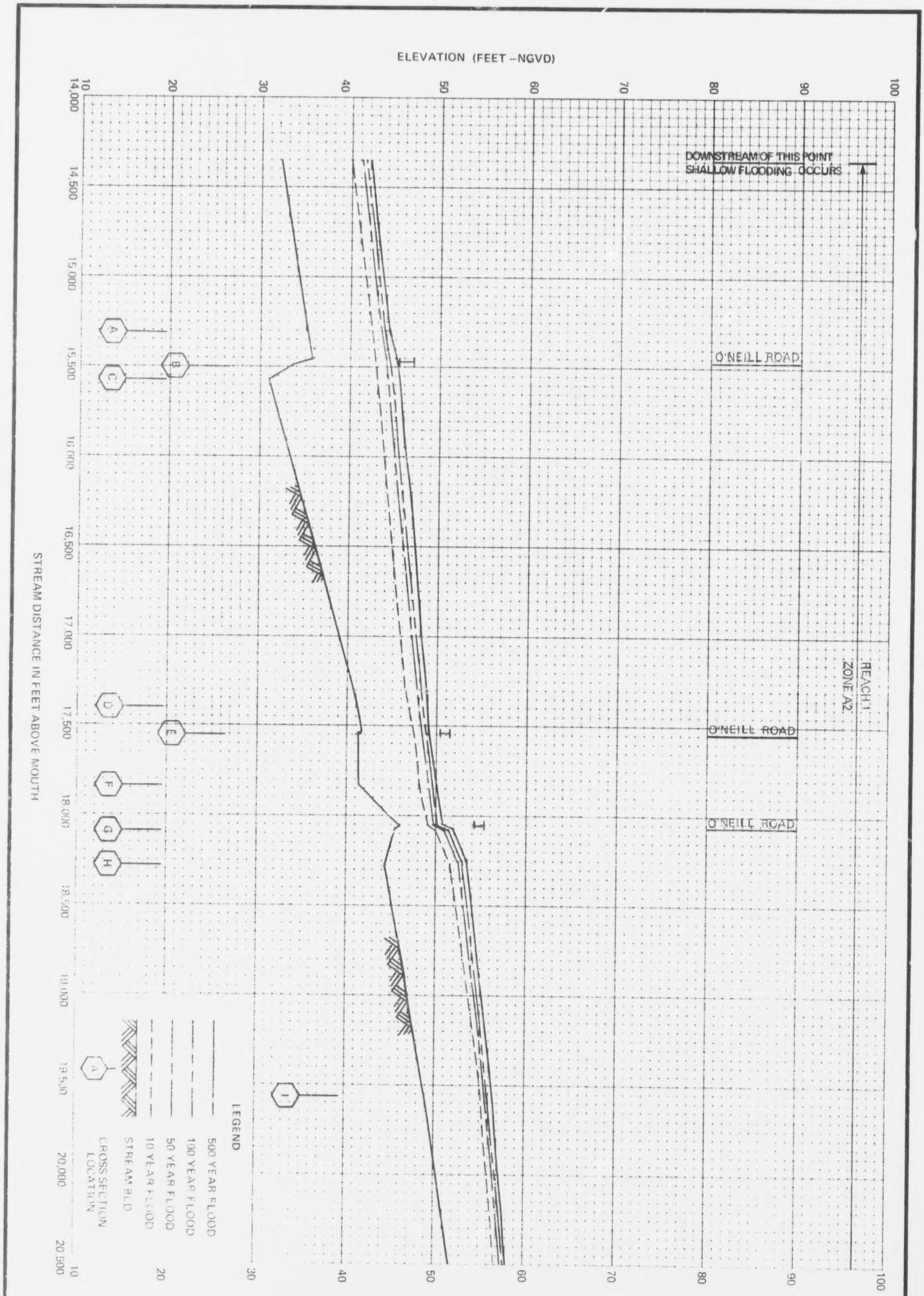
SATSOP RIVER

05P



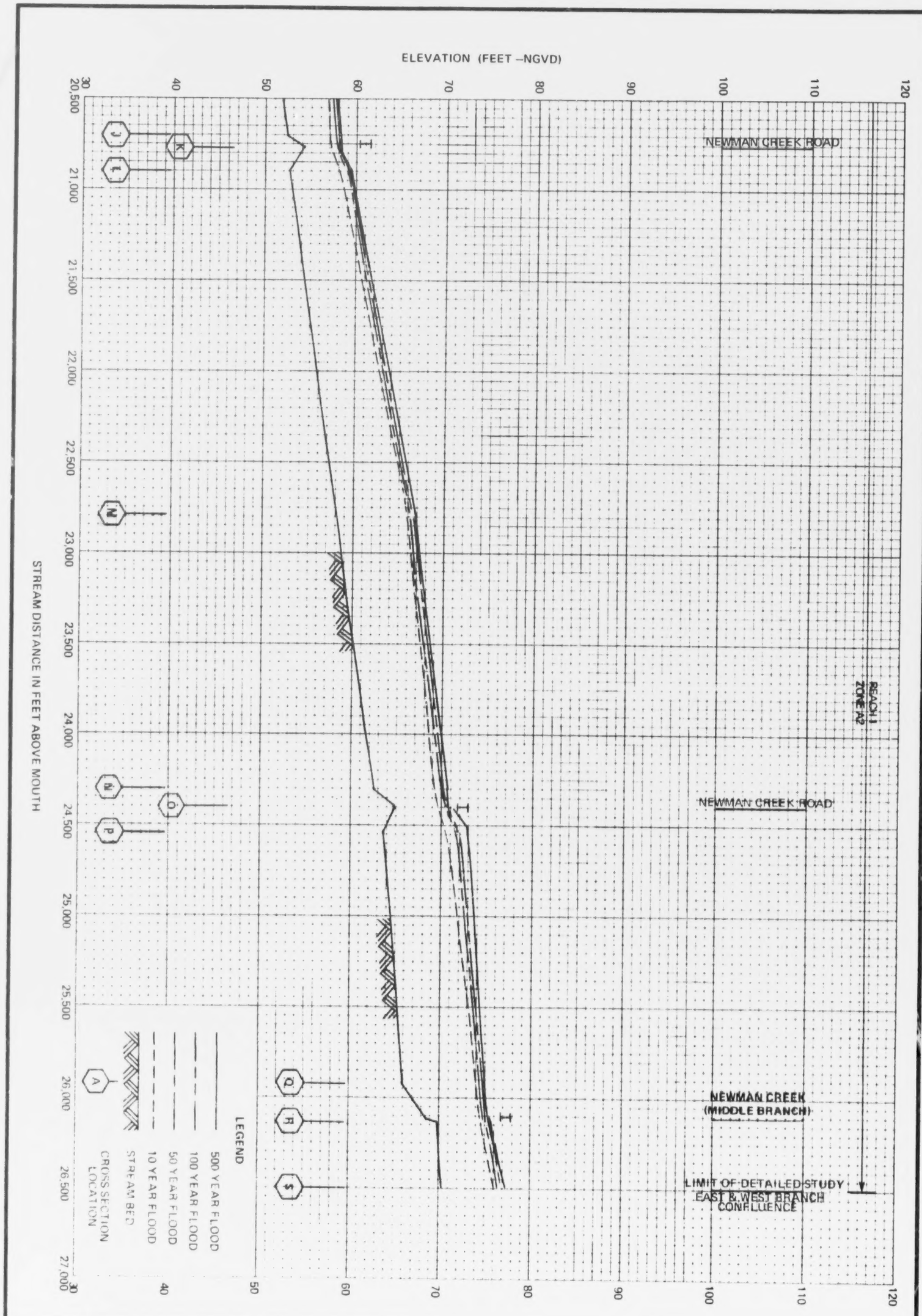
34

06P	FEDERAL EMERGENCY MANAGEMENT AGENCY **GRAYS HARBOR COUNTY, WA** **(UNINCORPORATED AREAS)**	**FLOOD PROFILES** SATSOP RIVER



35

07P	FEDERAL EMERGENCY MANAGEMENT AGENCY **GRAYS HARBOR COUNTY, WA** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **NEWMAN CREEK**



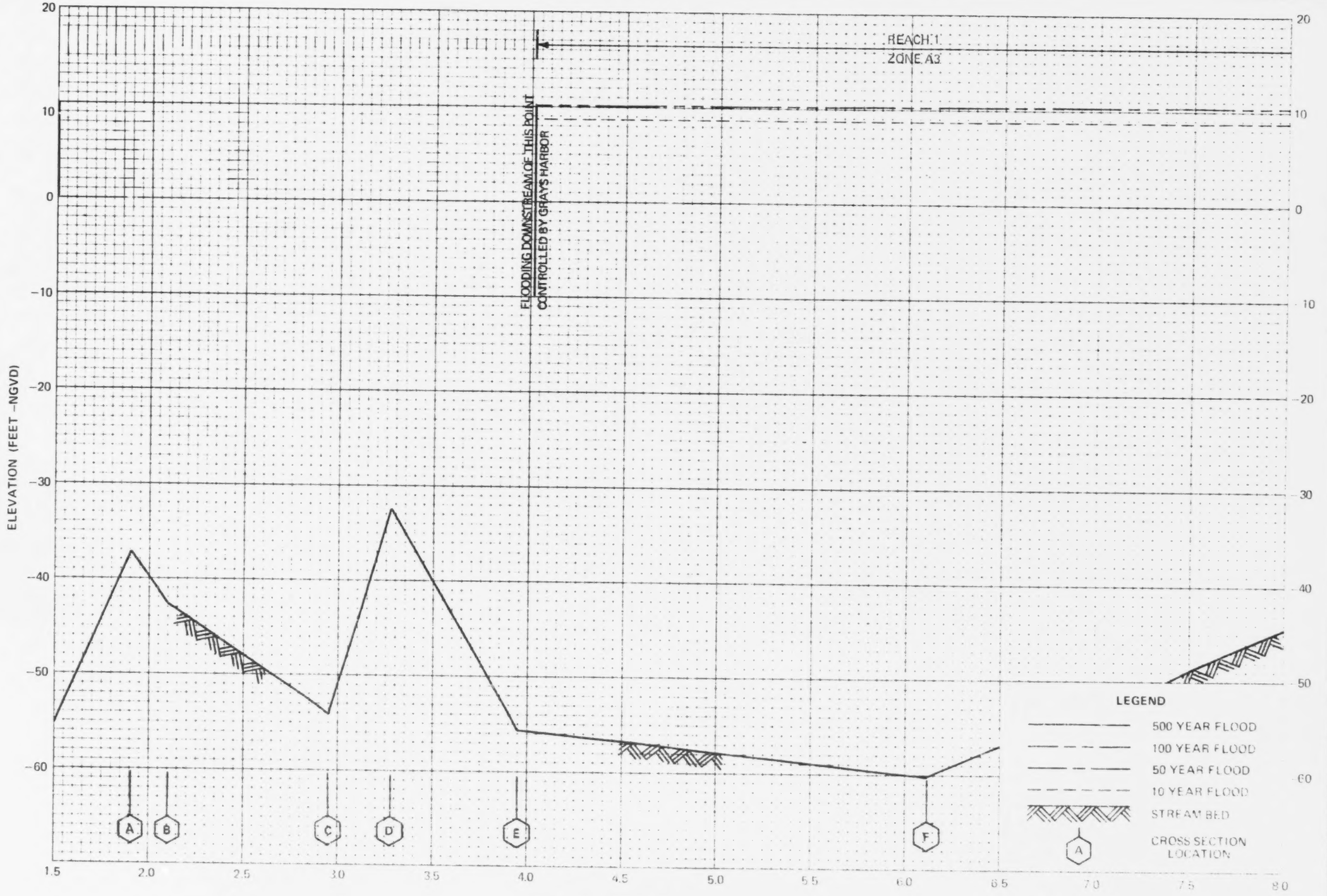
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

NEWMAN CREEK

08P



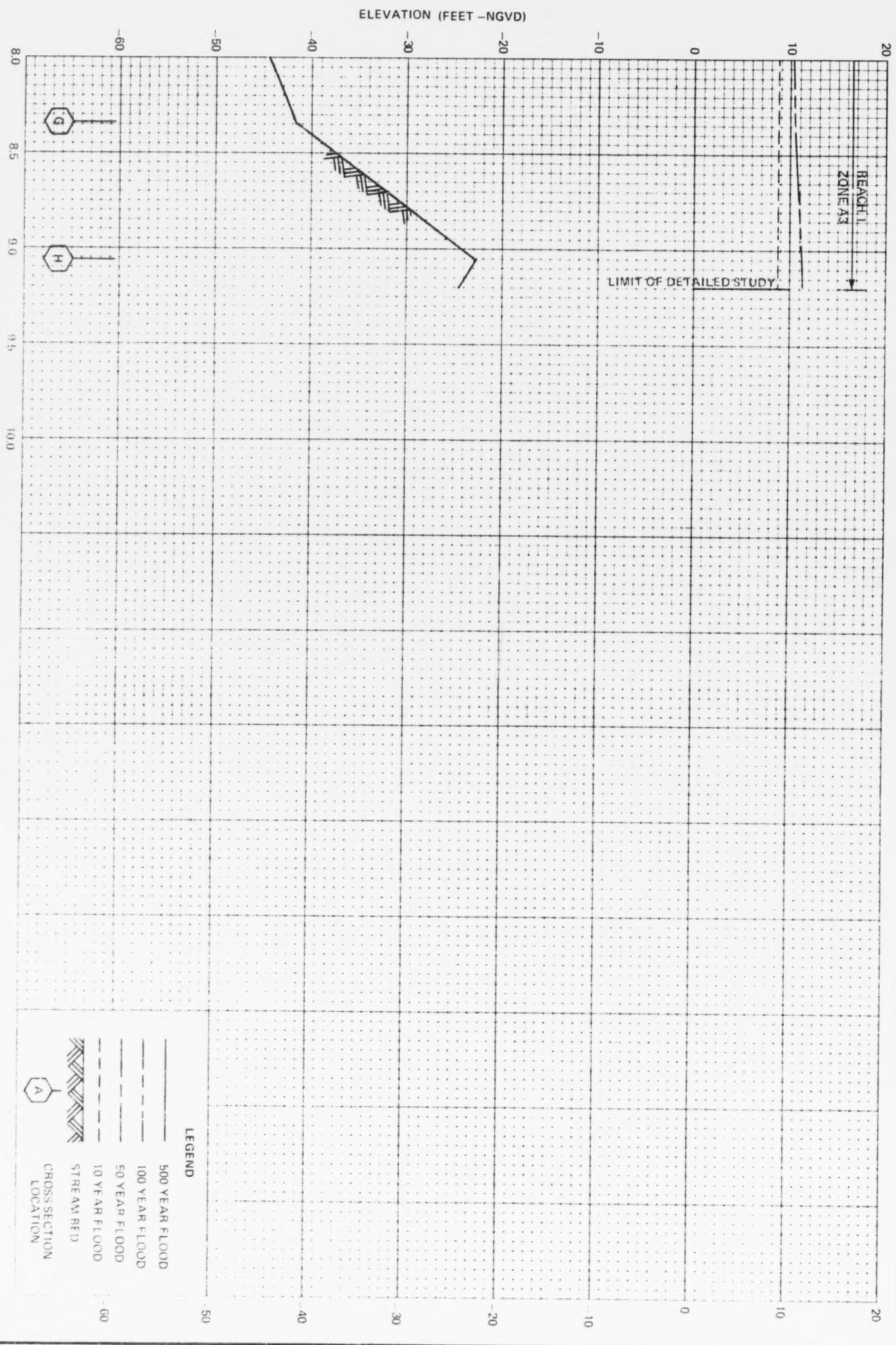
FLOOD PROFILES

CHEHALIS RIVER

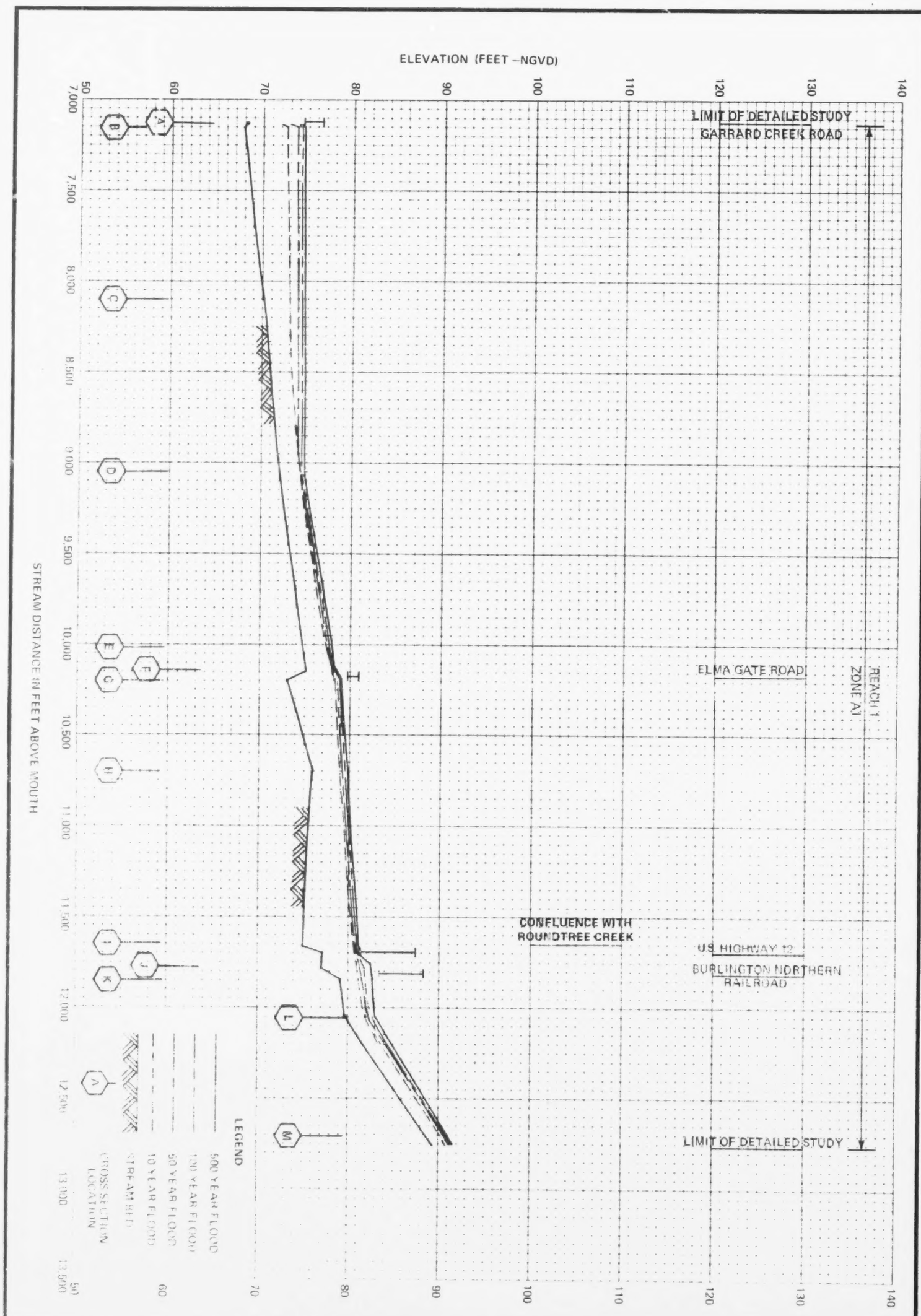
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

09P



10P	FEDERAL EMERGENCY MANAGEMENT AGENCY **GRAYS HARBOR COUNTY, WA** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **CHEHALIS RIVER**



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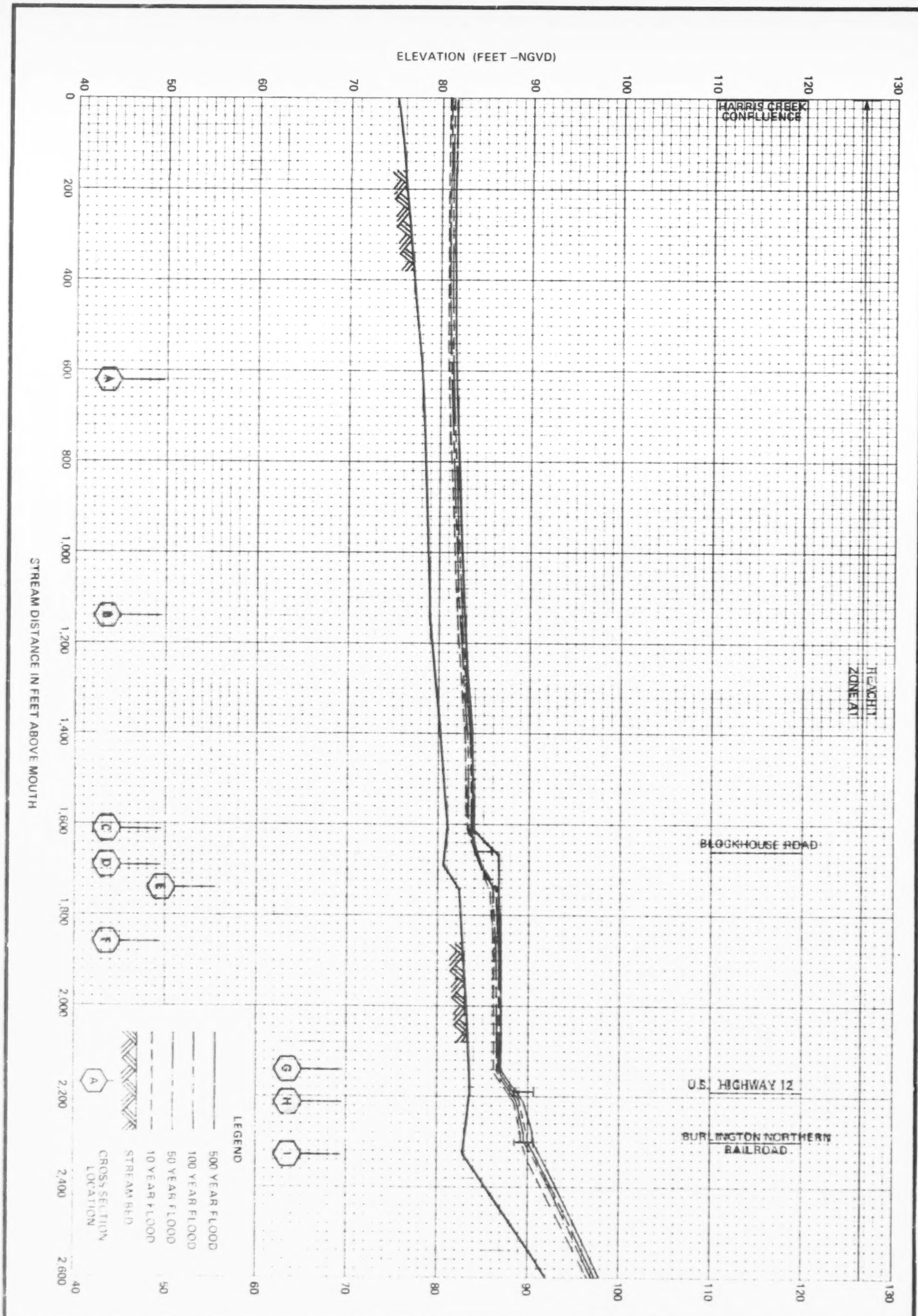
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

HARRIS CREEK

11P



FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

ROUNDTREE CREEK

12P

REACH 1
ZONE A1

LIMIT OF DETAILED STUDY

ELEVATION (FEET –NGVD)

130
120
110
100
90
80
70
60
50
40

2,600
2,800
3,000

J

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

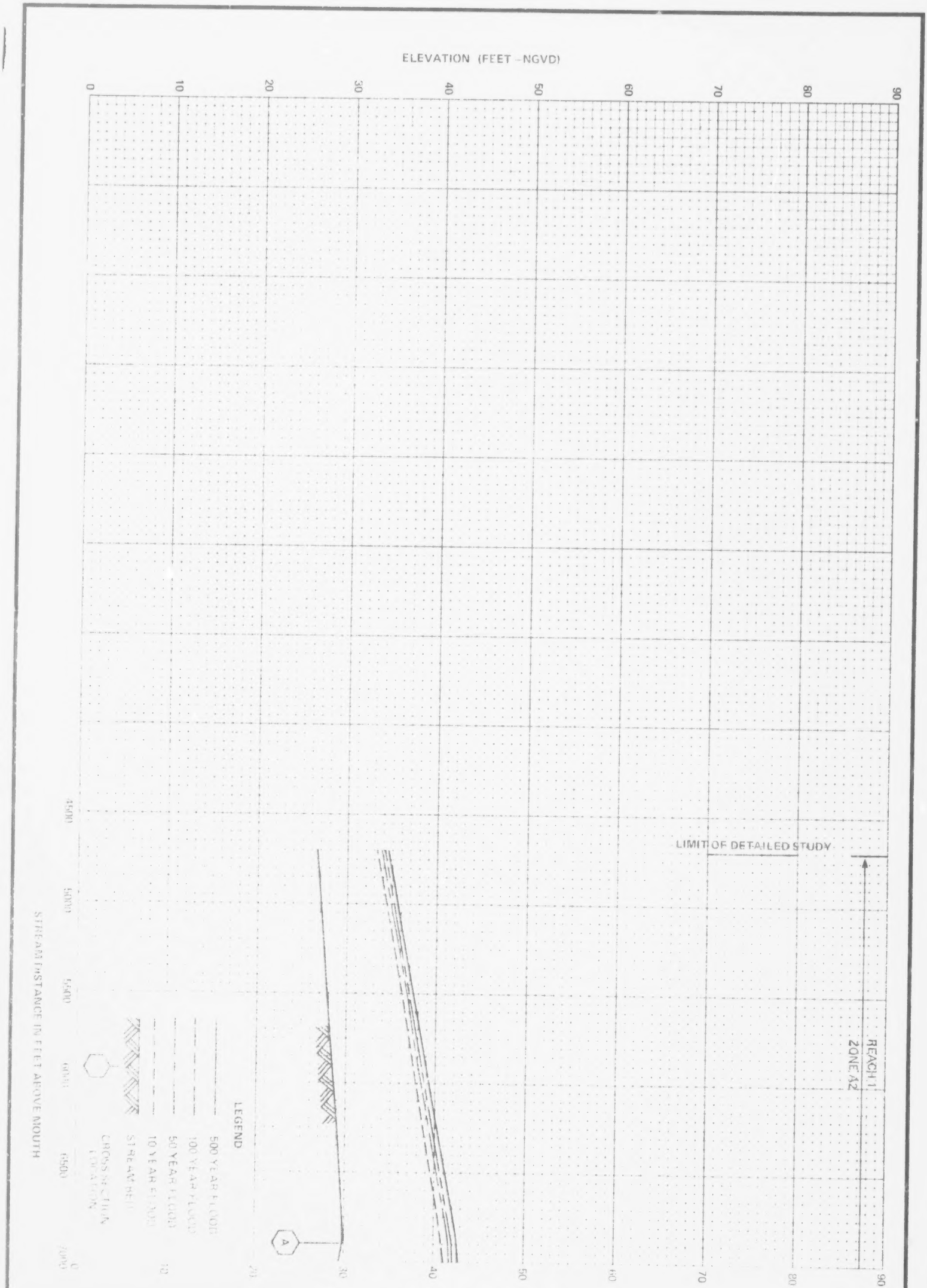
FLOOD PROFILES

ROUNDTREE CREEK

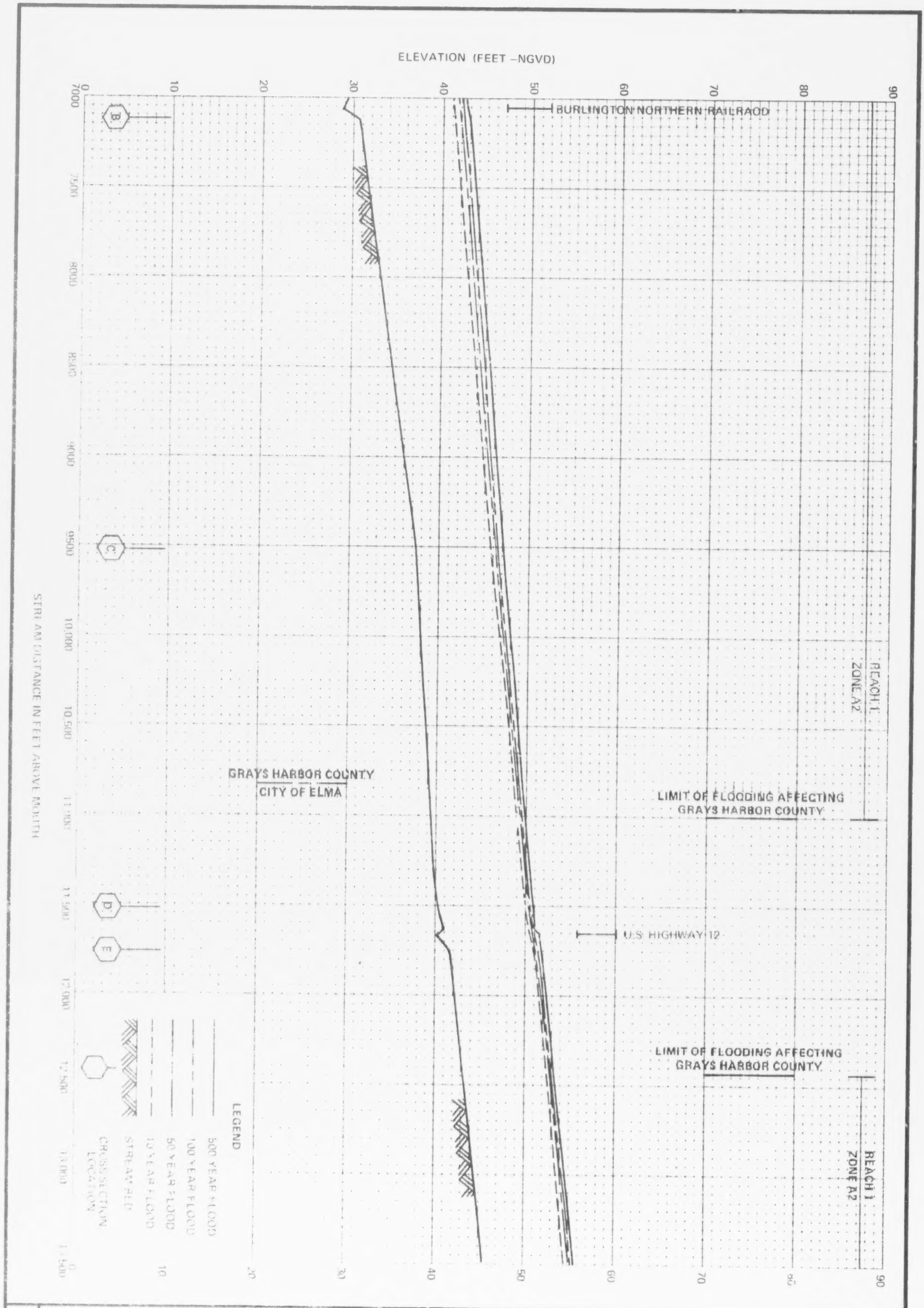
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

13P



14P	GRAYS HARBOR COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES CLOQUALLUM CREEK



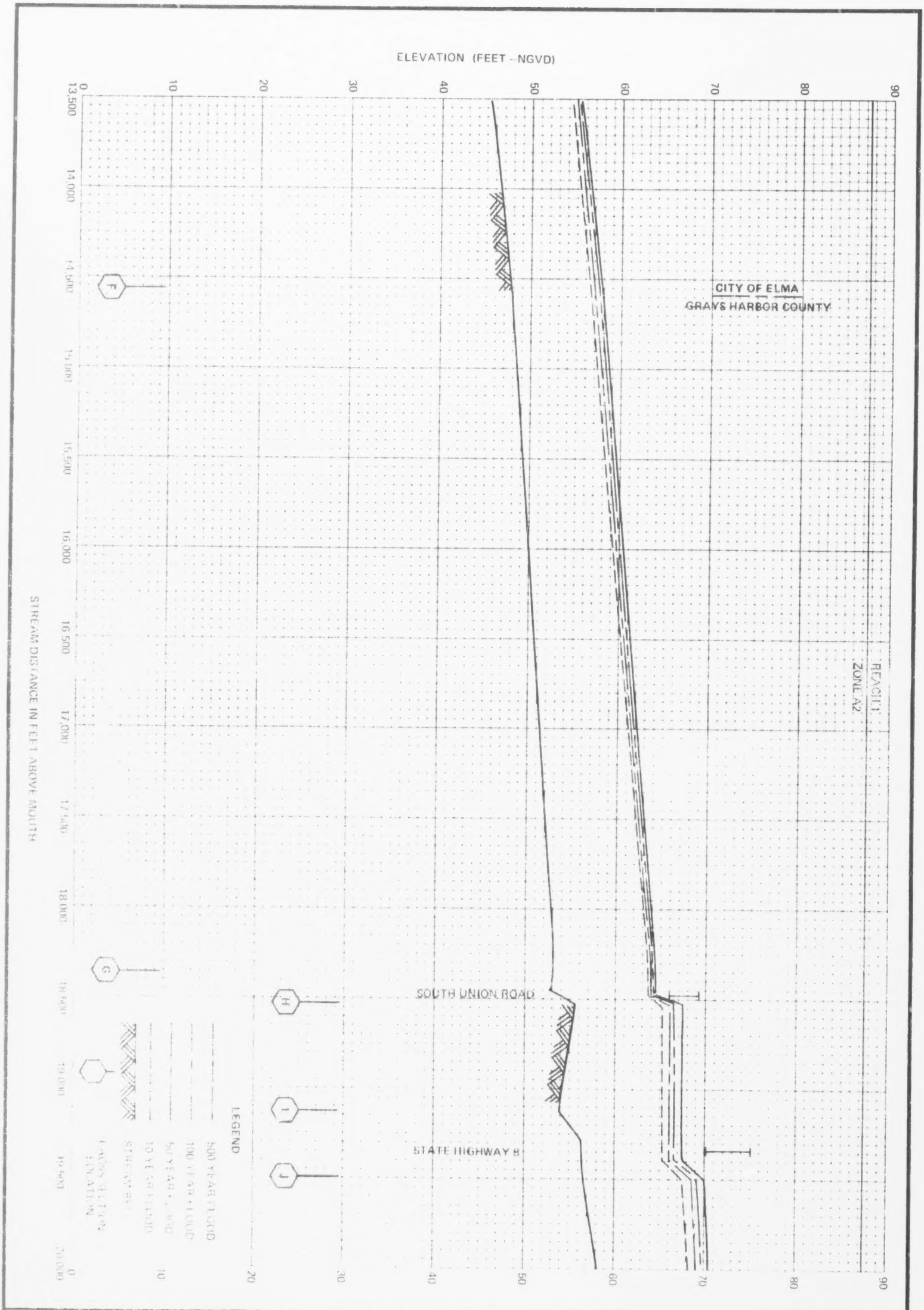
FEDERAL EMERGENCY MANAGEMENT AGENCY

15P

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CLOQUALLUM CREEK



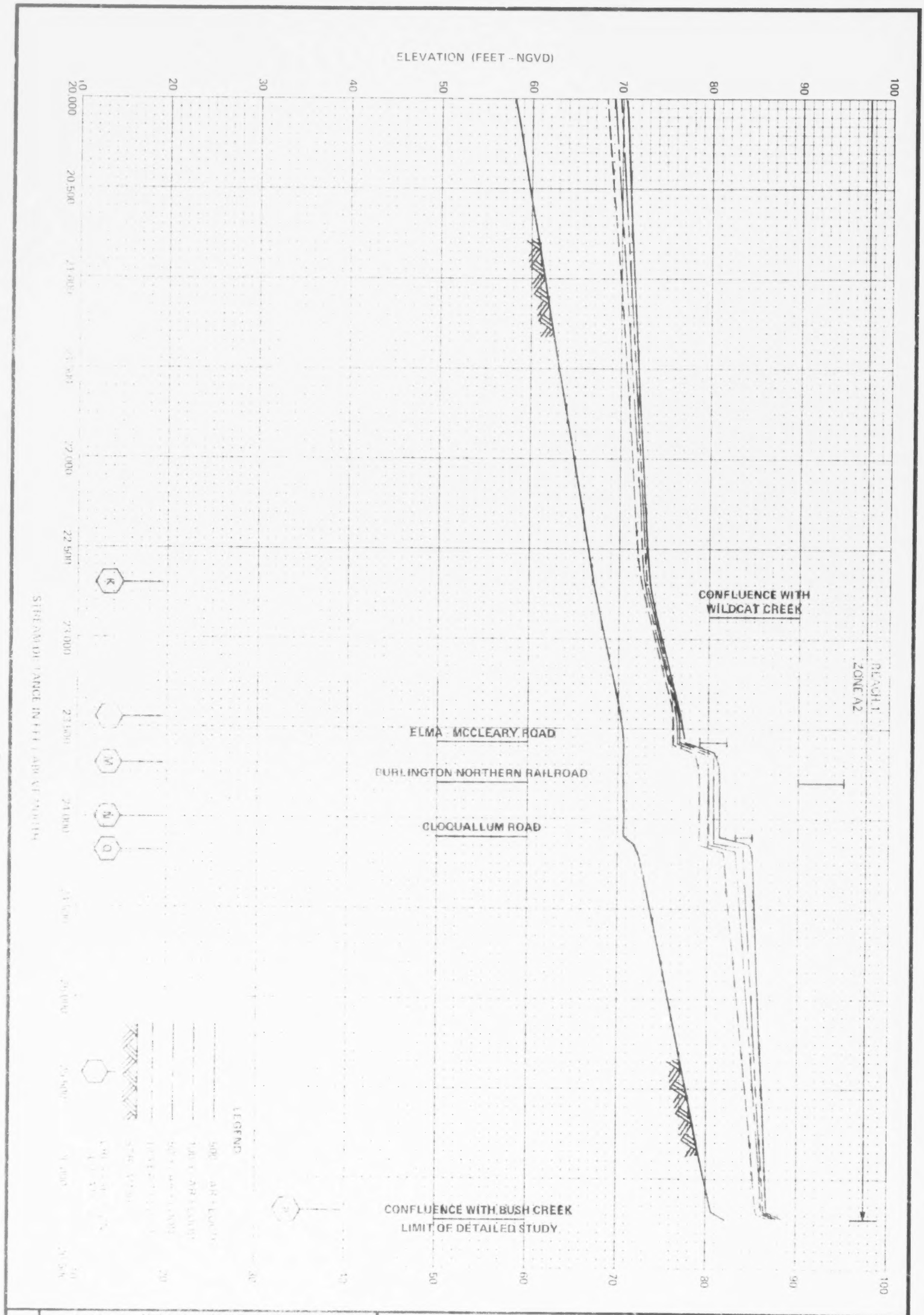
16P

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CLOQUALLUM CREEK



17P

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CLOQUALLUM CREEK

18P

GRAYS HARBOR COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

BUSH CREEK